Sink or Float?:

Exploring the Laws of Buoyancy

Grades 6-8

Using AIT Products

- *Super Science Sleuth*, program 5, "Feel the Power" AND
- *It's a Gas!: Math & Science of the Blimp*, program 7, "Buoyancy"

Overview

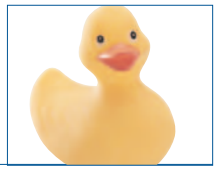
According to legend, a Greek mathematician named Archimedes got into a tub and noticed that the water spilled over the sides. He realized that there was a relationship between his weight and the amount of water pushed aside. Archimedes conducted more experiments and discovered how to determine if an object will float. In this lesson students will investigate Archimedes' Principle by observing floating objects and conducting experiments. Students will also discover the relationship between density and buoyancy.

Objectives

- Define the terms *buoyancy* and *density*.
- Explain how to predict whether an object will float or sink.
- Relate buoyancy to density.
- Use knowledge about buoyancy and density to explain why things float and determine how much weight an object can carry before sinking.

Vocabulary

air	float
blimp	gas
buoyancy	mass
density	sink
displace	volume



"A body immersed in a fluid is buoyed up by a force equal to the weight of the displaced fluid."

—Archimedes' Principle

Preparation

Materials Needed

- Aquarium or large plastic tub that can hold at least two gallons of water
- Toy boats, rubber ducky
- One 12 fluid ounce can of regular soda
- One 12 fluid ounce can of diet soda
- AIT video: *Super Science Sleuth,* program 5, "Feel the Power"
- Sheets of aluminum foil
- Large pail
- Dry-cleaner plastic film bags (Select a bag with the thinnest possible plastic and have several on hand.)
- Cellophane tape
- Heat source (Blow dryer, Sterno®, backpacker camp stove, etc.)
- AIT video *It's a Gas!: Math & Science of the Blimp,* program 7, "Buoyancy"
- 11-inch balloons inflated with helium
- String
- Paper clips

Planning Notes

Each day begins with a demonstration. They are fairly easy to do, but you may want to practice each demonstration before class.

Time

This project will take about two 60-minute class periods, in addition to homework and extension activity time.

Procedure—Day 1

Introduce Topic: Sink or Float?

Explain to students that they will be exploring why objects float in water. Fill an aquarium or large tub with water. Place a toy boat or rubber duck in the water and ask students to observe the object floating. Then facilitate a discussion in which the students consider why the object floats. Encourage students to explain their reasoning.

Show students a 12-ounce can of diet soda and a 12-ounce can of regular soda. You may want to let students hold each can so they can determine if the cans are different sizes and weights. Ask students to predict if both cans will float in the aquarium or a tub filled with water. Then place both cans in the water. Have students speculate why the can of regular soda did not float.

Explain to students that a Greek mathematician named Archimedes discovered why some objects float and others sink. According to Archimedes, it has to do with something called buoyancy.

Video

Tell students that they will watch a video that explains buoyancy. Cue program 5 from the series *Super Science Sleuth* to approximate time code 01:32. Instruct students to pay close attention during the video and write down the definition of buoyancy. PLAY through time code 03:45.

Ask the following questions after the video.

- Why do heavy boats and ships float on the water?
- Why do some boats and ships sink?
- What is buoyancy?
- Why did the can of diet soda float?

Make sure students understand that when you put something into water, it pushes away, or displaces, a certain amount of water. For example, when you put a rubber duck into a full bathtub, water will move to the side. Because the weight of the displaced water is heavier than the weight of the rubber duck, the duck floats. If the rubber duck was filled with lead weights instead of air, it would be heavier than the amount of displaced water and would sink.

Class Activity: Raft Building Contest

Divide students into groups of three or four. Tell students that you will have a raft building contest. The raft that can support the most marbles without sinking in a pail of water wins.

Give each group identically-sized sheets of aluminum foil and explain that they have 15 minutes to make several rafts. They are not allowed to cut the sheets or tape the sheets together. They can only build rafts by bending up the sides of the sheet of aluminum foil. At the end of 15 minutes, have students choose their best design to enter into the competition.

Test the rafts one at a time by slowly adding marbles until the raft begins to sink. Discuss why some designs worked better than others.

Procedure—Day 2

Introduce New Topic: How Things Float in Air

Facilitate a discussion in which students consider how the atmosphere is like the ocean. Ask students to describe what the atmosphere and the ocean share in common. Students may say that both consist of fluids, both have current systems, or that both create pressure that changes with depth.

Visit the Glenn Learning Technologies Web site. Follow the instructions and demonstrate for students how a hot-air balloon works. Have students think about what they know about buoyancy and the atmosphere and then speculate why hot-air balloons float.

Video

Explain to students that hot-air balloons and blimps can float in the air thanks to buoyancy. They will now watch a video that explains how objects can float in the air. Cue program 7 from the series *It's a Gas!: Math & Science of the Blimp* to approximate time code 03:36. PLAY through time code 07:38.

Discuss the following topics after viewing the video.

- Describe the relationship between density and buoyancy.
- Why does a hot-air balloon float?
- Why does a blimp float?
- How does the volume of helium in the blimp affect the amount of weight it can lift?

Group Work: How Much Weight Can a Helium Balloon Carry?

Show students an 11-inch balloon that has been inflated with helium and a paper clip. Explain to students that one paper clip weighs approximately one gram. As a class, determine the density of the helium balloon. Then ask students to calculate how many grams the balloon can lift before sinking to the ground.

Have students conduct an experiment to determine how much weight their helium balloon can lift before sinking. Divide students into groups of three or four. Give each group one 11-inch helium balloon with string tied at the bottom and at least 30 paper clips. Ask students to slowly attach paper clips to the string at the bottom of the balloon until the balloon no longer floats. Have students compare results. Then have

them compare their experimental results with their calculated results.

Assessment

Individual Assessment

Check for deep understanding of the concepts by assigning students to write a paragraph explaining why a rowboat can float. This paragraph should also explain how to calculate how much weight the rowboat can carry before it will sink.

Group Assessment

Divide students into groups of three or four. Give each group a toy boat and some marbles. Have students calculate how much weight the boat can hold before sinking. Ask students to conduct an experiment to determine how much weight the boat can hold. Then have them explain how they calculated how much weight the boat can hold and compare their experimental results with their original calculations.

Extension Activity: Archimedes

Have students conduct research and learn more about Archimedes and his discoveries. Then have them create their own demonstration of Archimedes' Principle.

Resources

Science Learning Network: Air Travelers

www.omsi.edu/visit/physics//air

The Science Learning Network Web site includes information on buoyancy, the properties of gases, temperature, and the technology involved in hot-air ballooning. This Web site also includes simple classroom activities and a list of questions that can be used for inquiry projects.

NOVA: Buoyancy Basics

www.pbs.org/wgbh/nova/lasalle/buoybasics.html

This Web site has an online interactive activity that explains the connection between the amount of water displaced by an object and the object's density.

Exploratorium: Buoyancy

www.exploratorium.edu/xref/phenomena/buoyancy.html

This Web site includes Exploratorium exhibits that demonstrate buoyancy and other related phenomena.